(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 574 634 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **92401653.8**

(51) Int. Cl.5: **A63H 30/04**, G08C 15/12

(22) Date of filing: **15.06.92**

(43) Date of publication of application:
22.12.93 Bulletin 93/51

(84) Designated Contracting States:
DE FR GB IT

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(54) Toy car remote control device.

(57) The invention relates to a toy car remote control device, the said toy car having electrically powered functions including:

- a transmitter which transmits a radio signal and,
- a receiver which receives the said signal and controls the functions of the car,
- the said signal being a digital waveform composed of serial data (3-5) organized within a time frame (6).

The said serial data codes comprise two identification code pulses, or ID code pulses, and control code pulses, each control pulse controlling a function of the toy car.

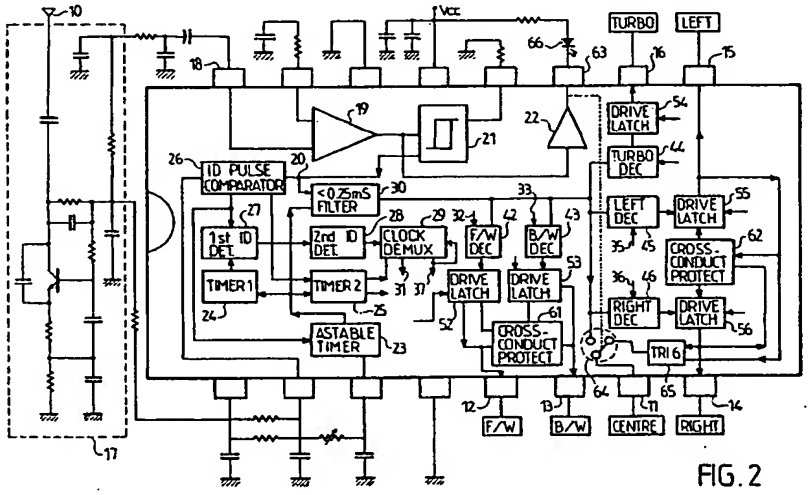

FIG.2

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FIELD OF THE INVENTION

The invention relates to a remote control device for toy cars. More particularly, it relates to a remote control device which uses radio signals to control the toy's electrically powered functions.

DESCRIPTION OF THE PRIOR ART

Toy car radio remote control devices already exist and can be either complex or simple and cheap. However, the performance of the second category is often poor and they sometimes generate spurious commands. This is particularly true, for example, when :

- the transmitter has been switched off but the receiver in the toy car has been left on : some of the toy's functions may be activated by spurious interference received by the receiver.
- the transmitting and receiving antennas physically touch each other and generate spurious interference.
- the receiving antenna comes into contact with metal objects.
- somebody physically touches the receiving antenna.

SUMMARY OF THE PRIOR ART

Some objects of the invention are to provide an inexpensive, reliable toy car remote control device for controlling the electrically powered functions of a toy car.

Further objects of the invention are to provide such a device that overcomes the drawbacks associated with old technology devices as listed above.

In its basic form, the invention comprises a transmitter that transmits a radio signal, and a receiver that receives the said signal and controls the functions of the car.

The signal is a digital waveform composed of serial data organized within a time frame.

The serial data codes comprise two identification code pulses, or ID code pulses, and control code pulses, each control pulse controlling a function of the toy car.

The receiver only processes the control code pulses if they are received with the two identification pulses.

Spurious interference detected by the receiver is unlikely to be structured in the same way as the signal sent by the transmitter and so there is no risk of the receiver interpreting such interference as a radio control signal sent by the transmitter.

In various embodiments of the invention, the toy car remote control device will have the following features either separately or several together:

- the functions of the toy car are a direction control, a speed function and a steering control;
- the value produced by at least one of the control pulses controlling a function of the toy car depends on the duration of the control pulse;
- any spike or noise with duration less than 0.25ms will be filtered out by internal digital filter ;
- the receiver comprises a built-in tone amplifier with closed loop gain, a means for clamping the level of the code pulses and a decoder;
- the decoder comprises at least one pulse width comparator;
- the decoder comprises several pulse width comparators, each one corresponding to a specific code pulse, together with a clock demultiplexer which enables the respective pulse width comparator at the instant its corresponding code is available;
- the decoder comprises several latches, each one corresponding to a code pulse, and which are triggered by the respective pulse width comparator to control an output, each output being protected against cross-conducting by Nand gates;
- the receiver comprises a light-emitting diode that flashes when no signal is being received by the receiver.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a representation of the data waveform.

Figure 2 is a block diagram of the receiver of the invention.

Figures 3 and 4 are schematic diagrams of the data decoder of the invention.

Figure 5 is a timing diagram showing how the invention functions.

Figure 6 is a flow chart of the operations performed.

DETAILED DESCRIPTION

The invention relates to a toy car remote control device.

It comprises a transmitter and a receiver. The transmitter sends a radio signal that the receiver receives and uses to control the car's functions.

These functions are usually electrically powered functions such as direction control (forward or reverse), steering (left or right) and turbo (acceleration in speed).

The signal transmitted by the transmitter is represented in Figure 1. It is a digital waveform

comprising serial data codes 1-5 organized with a time frame 6.

This time frame 6 is regularly repeated whenever any control key of transmitter is pressed, the duration of each frame ranging from 15 to 20ms.

The first two pulses 1,2 of each frame are ID code pulses. The duration of these ID code pulses is fixed at 4ms each, for example.

The third pulse 3 is the direction control code pulse that the receiver interprets according to the width or duration of the said pulse. A narrow direction code pulse is interpreted as "forward" and a wide direction code pulse as "reverse".

The fourth pulse is the turbo code pulse. It is interpreted on the basis of being present or absent in the time frame. When the turbo code pulse is present, this means that the turbo function is to be activated, and when the said pulse is absent, this means that the turbo function is to be deactivated.

The fifth and last pulse 5 is the steering code pulse. Like the direction code pulse, the steering code pulse is interpreted on the basis of its width or duration. For a narrow steering code pulse, the steering actuator must steer the car to the left, and for a wide steering code pulse, the steering actuator must steer the car to the right. When no steering code pulse is present in the time frame, the steering actuator must keep the steering centralized.

The width of a narrow direction or steering code pulse is 0.5ms and that of a wide direction or steering code pulse 2ms.

The width of the turbo code when present in the frame is 0.5ms.

The two ID code pulses are separated by a time interval 7 of 0.5ms, with a time interval 8 of 1.5ms separating the second ID code pulse and the first control code pulse.

Successive frames are separated by a free time interval of approximately 2ms.

A block diagram of the receiver carried by the toy car is shown in Figure 2. The receiver provides the control signal for each of the car's electrically powered functions on a separate output.

The RF signal is received by antenna 10. Output pins 11 to 16 each correspond to a value of a function of the car to be activated.

The signal received by antenna 10 passes through the RF front-end circuit 17 to input pin 18. The signal is then fed to a built-in tone amplifier 19 providing a closed loop gain of 60dB. Tone amplifier 19 provides a constant maximum level digital signal at point 20 therefore mitigating the effects of any variation in received signal strength.

The signal at the output of amplifier 19 is also sampled by LED driver 22. LED driver 22 makes LED 66 flash whenever there is no output signal from amplifier 19, and stops it flashing as soon as a signal reappears on the output of amplifier 19.

This is particularly useful for providing a visual indication of the car being out of remote control range.

A synchronized astable timer 23 provides a string of 0.25ms clock pulse signals which control two timers 24, 25.

These 0.25ms clock pulses are also applied to a pulse width comparator operating as a digital filter 30 to reject any spike and noise before performing data decode.

First timer 24 together with pulse comparator 26, first ID detector 27 and second ID detector 28 allow the receiver to recognize that the received signal is a valid signal and not spurious interference.

For a valid signal, second timer 25 activates clock demultiplexer 29. Clock demultiplexer 29 has seven outputs, each corresponding to a value of one of the control pulses.

Each of these outputs 32 to 36 is connected to a corresponding decoder 42-46, or pulse width comparator, that also receives the data from the signal. On decoding the data, decoder 42-46 operates a drive latch 52-56 that is connected to a corresponding output pin 12-16.

Output pin 11 corresponds to the "centre" steering code which is automatically selected in the absence of a "left" or "right" steering code pulse in the received signal frame.

Protection circuits 61 and 62 are provided between the drive latches for direction and steering to protect against cross-conducting.

In concern of system integration into a chip with pin limited, it is preferrable to monitor performance of digital signal after passed amplifier 19, schmitt trigger 21, and digital filter 30. In order to be measured the signal at pin 11, just biased pin 63 to supply voltage. At normal condition, switch 63 is always connected to left and right latch through a logical circuit 65.

Figures 3 and 4 propose detailed practical circuit diagrams of the functions represented on the block diagram in Figure 2.

The signals transmitting the serial codes from the transmitter are received and fed to "Data In" pin 18. The pulses are then shaped by Schmitt-triggered circuit 101 which comprises two Quad 2-Input Schmitt-triggered Nand Gates 102, 103. One shot timer 104 is a Monostable Multivibrator which generates a 3.8ms pulse on each positive-going transition of the data codes.

This pulse is sent through circuit 105 to ID detector 108.

Circuit 105 comprises two Quad 2-Input Schmitt-triggered Nand Gates 106, 107. ID detector 108 is a Dual J-K Flip-Flop with Clear.

The operation of astable timer 23 is synchronized at falling edge of output from detector 108 to provide a string of 0.25ms clock pulses.

If the second ID code pulse is detected before or on the fourth clock pulse available, a first ID detector 27 will be toggled and enable the second ID detector 28.

However, if the second ID code pulse has not been received before or on the fourth clock pulse, ID detector 27 will be reset automatically on the fifth clock pulse.

The process for the second ID detector 28 is the same as that for the first ID detector 27 except that second ID detector 28 enables a four-bit ring counter 116-125 and first ID detector 27 enables a three-bit ring counter 110-115.

Clock demultiplexer 29 is synchronized by astable timer 23, and is activated by a signal received from the second ID detector 28 through Quad 2-Input Nand Gate 109 together with Hex Inverter 130 and 131.

Clock demultiplexer 29 and its associated components 116-125 produce five clock signals.

Each clock signal, respectively 202, 203, 204, 205 and 206, supplied by clock demultiplexer 29 is correctly timed to coincide with one of the control code values. It is directed to a pulse width comparator 302-306 which receives the signal's digital data via filter 30 and can send a signal to drive latches 402-406 which in turn send a signal to output pin 12-16. The pulse width comparators each comprise a Dual J-K Flip-Flop with Clear, each receiving data signals on the clock pulses.

The drive latches each comprise two Quad 2-Input Nand Gates in combination with two Quad 2-Input Nor Gates.

Many different components can be used to put the invention into practice, however when using those from the applicant (SGS-THOMSON firm), the following numbered components can be used :

- as Quad 2-Input Schmitt Nand Gate 102, 103, 106, 107 : HC 132,
- as Dual J-K Flip-Flop with Clear 27, 28, 108, 110, 111, 114, 116, 117, 120, 123 : HC 73,
- as Dual Precision Monostable Multivibrator 23 : 4538,
- as Quad 2-Input Nand Gate 109, 118, 121, 124, 422, 423, 424, 425, 426 : HC 00,
- as Quad 2-Input Nand Gate 412, 413, 414, 415, 416 : HC 08,
- as Hex Inverter 119, 122, 125, 126, 130, 131 : HC 04,
- as Triple 3-Input Gate 112, 113, 115 : HC 10,
- as Astable Timer 23 : NE 555,
- as Clock Demultiplexer : HC 237,
- as Digital Filter 30 : HC 73.

Figure 5 shows the timing diagram of some of the most important signals in the receiver.

701 is the input signal, as already represented and described in Figure 1.

702 is the signal produced by astable timer 23 in response to the first ID code pulse.

704-709 are the signals produced by the clock demultiplexer, respectively on each of its outputs.

The operation of the device will now be described with reference to the flow chart in Figure 6.

First, when power is connected to the receiver, all functions are reset (601).

Data codes are then detected by the receiver (602).

The signals are amplified (603) to provide a maximum constant level and then shaped by a Schmitt-triggered circuit (604).

The first pulse operates the one-shot multivibrator (605) that performs the ID code pulse comparison (606).

The first ID code pulse is detected (607) and its positive-going edge brings the three-bit ring counter (608) into operation.

If the second ID code pulse is detected before or on the fourth clock pulse (609), the first ID detector will be toggled, enabling in turn the second ID detector (610).

However, if the second ID code pulse has not been received before or on the fourth clock pulse, ID detector 27 will be reset automatically on the fifth clock pulse.

The second ID code pulse is detected in the same way as the first ID code pulse (610-613), except that the ring counter is a four-bit ring counter (611).

When the first and the second ID code pulses are correctly detected, five separate clock pulses will be generated by the clock demultiplexer (29). These clock pulses will be used to control corresponding pulse detectors together with incoming digital signal for each of the control functions.

After detection, each pulse activates a latch that operates the corresponding function.

Claims

1. Toy car remote control device, the said toy car having electrically powered functions including:
   - a transmitter which transmits a radio signal and,
   - a receiver which receives the said signal and controls the functions of the car,
   - the said signal being a digital waveform composed of serial data (3-5) organized within a time frame (6).

   characterized in that the said serial data codes comprise two identification code pulses, or ID code pulses, and control code pulses, each control pulse controlling a function of the toy car.

2. Toy car remote control device according to claim 1, characterized in that it comprises an internal digital filter 30 to reject any spike or noise from the signal.

3. Toy car remote control device according to any of claims 1 and 2, characterized in that it comprises an amplifier 19 and a schmitt trigger 21 processing the signal before decoding.

4. Toy car remote control device according to any of claims 1 to 3, characterized in that the functions of the toy car are a direction control, a speed function and a steering control.

5. Toy car remote control device according to any of claims 1 to 4, characterized in that the value produced by at least one of the control pulses (3,5) controlling a function of the toy car depends on the duration of the control pulse.

6. Toy car remote control device according to any of claims 1 to 5, characterized in that the receiver comprises a built-in tone amplifier (19) with closed loop gain, a means for clamping the level of the code pulses and a decoder.

7. Toy car remote control devices according to claim 6, characterized in that the decoder comprises at least one pulse width comparator (42-46).

8. Toy car remote control device according to any of claims 6 and 7, characterized in that the decoder comprises several pulse width comparators (42-6), each one corresponding to a specific code pulse (29), together with a clock demultiplexer which enables the respective pulse width comparator (42-46) at the instant its corresponding code is available.

9. Toy car remote control device according to any of claims 6 to 8, characterized in that the decoder comprises several latches (52-56), each one corresponding to a code pulse, and which are triggered by the respective pulse width comparator to control an output.

10. Toy car remote control device according to claim 9, characterized in that it comprises Nand gates (61, 62) that protect each output against cross-conducting.

11. Toy car remote control device according to any of claims 1 to 10, characterized in that the receiver comprises a light-emitting diode 66 that flashes when no signal is being received by the receiver.

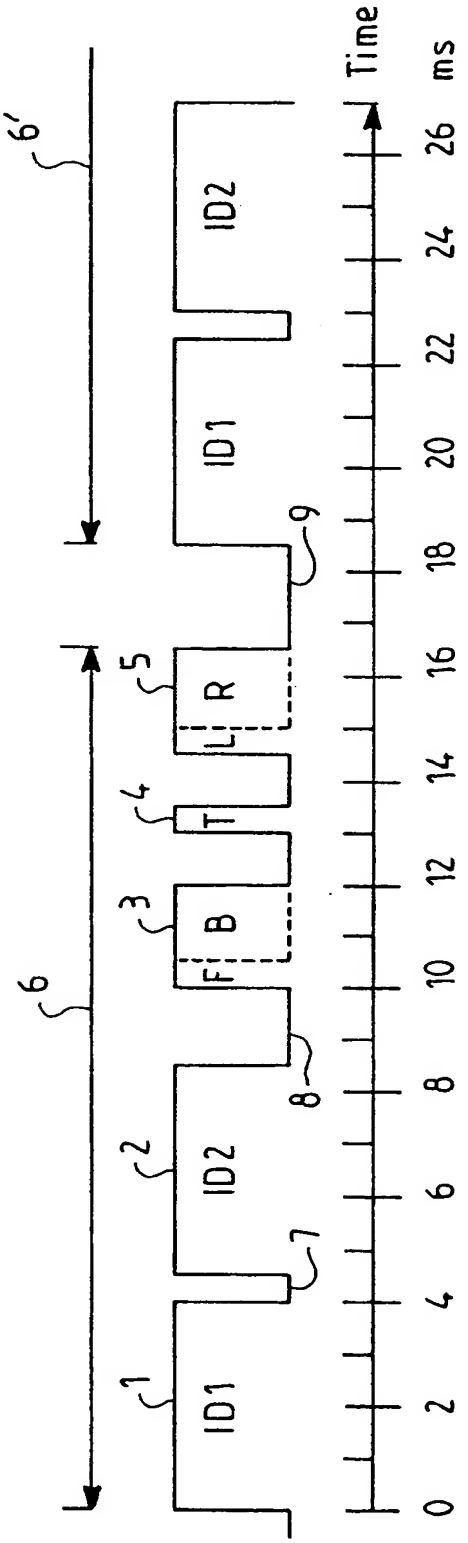
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FIG. 1

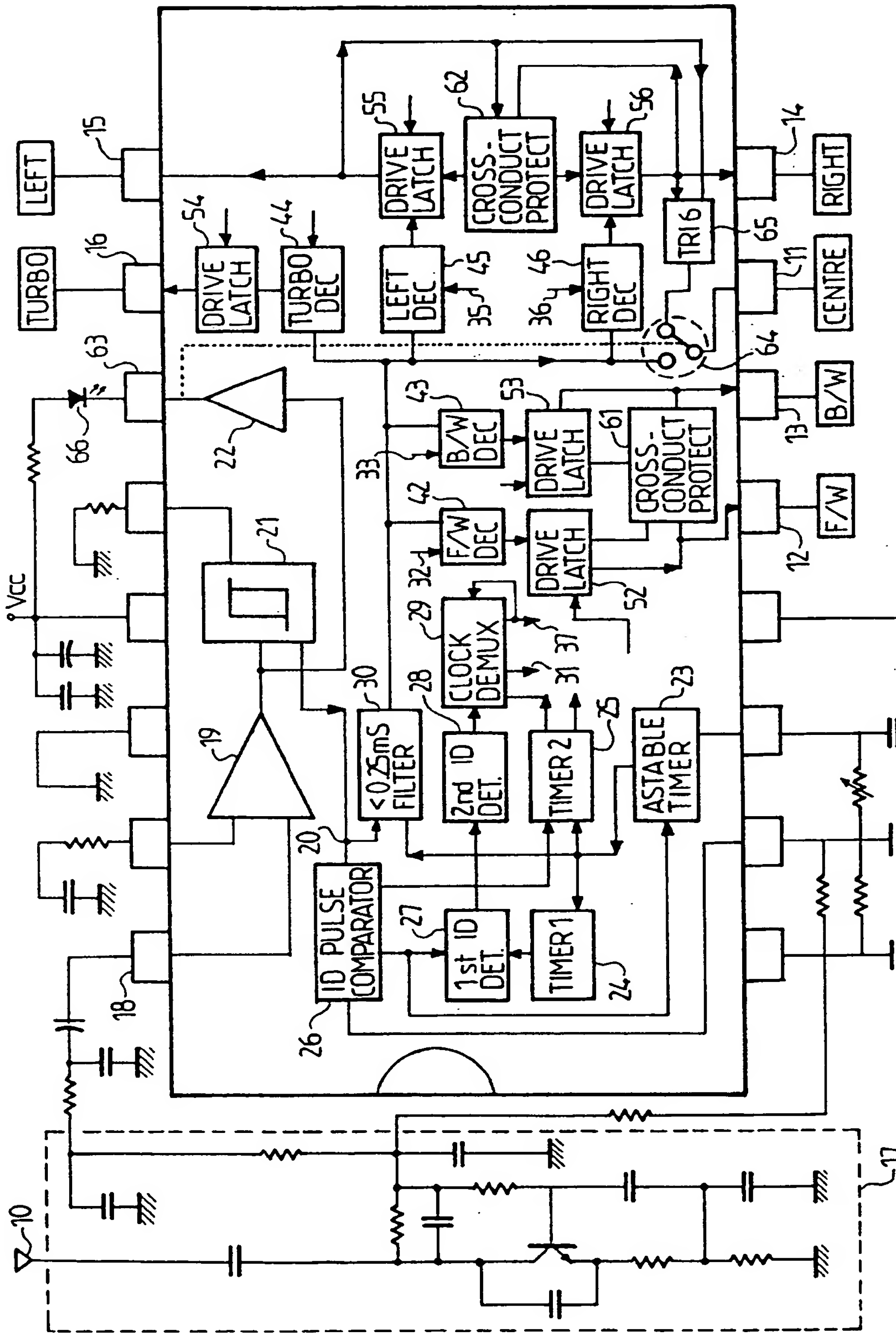

LEFT
TURBO
CENTRE
RIGHT
B/W
F/W
Vcc
DRIVE LATCH
TURBO DEC
LEFT DEC
RIGHT DEC
DRIVE LATCH
CROSS-CONDUCT PROTECT
DRIVE LATCH
TRI 6
B/W DEC
DRIVE LATCH
CROSS-CONDUCT PROTECT
F/W DEC
DRIVE LATCH
CLOCK DEMUX
<0.25mS FILTER
2nd ID DET.
TIMER 2
ASTABLE TIMER
ID PULSE COMPARATOR
1st ID DET.
TIMER 1

FIG. 2

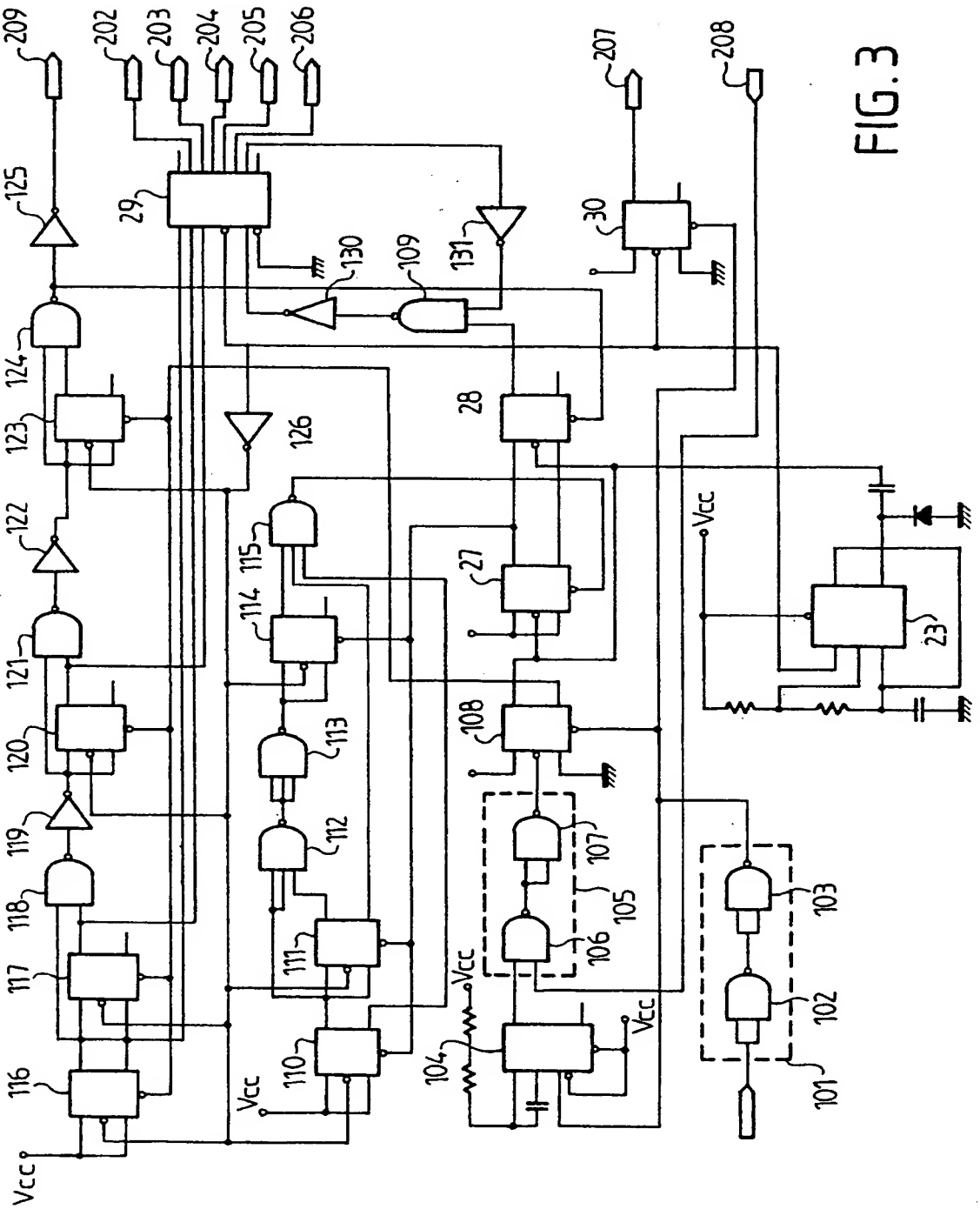


FIG. 3

FIG. 4

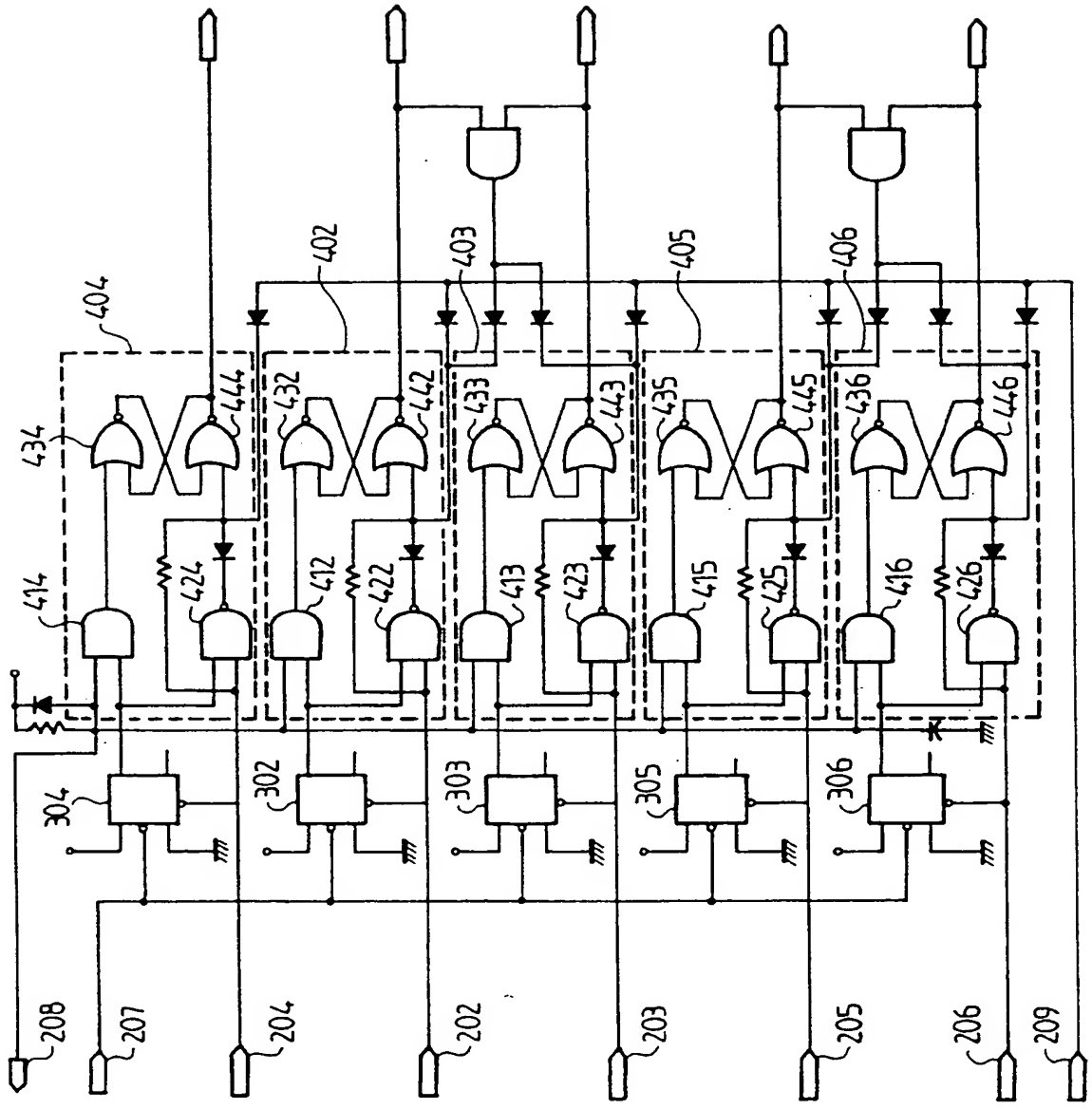
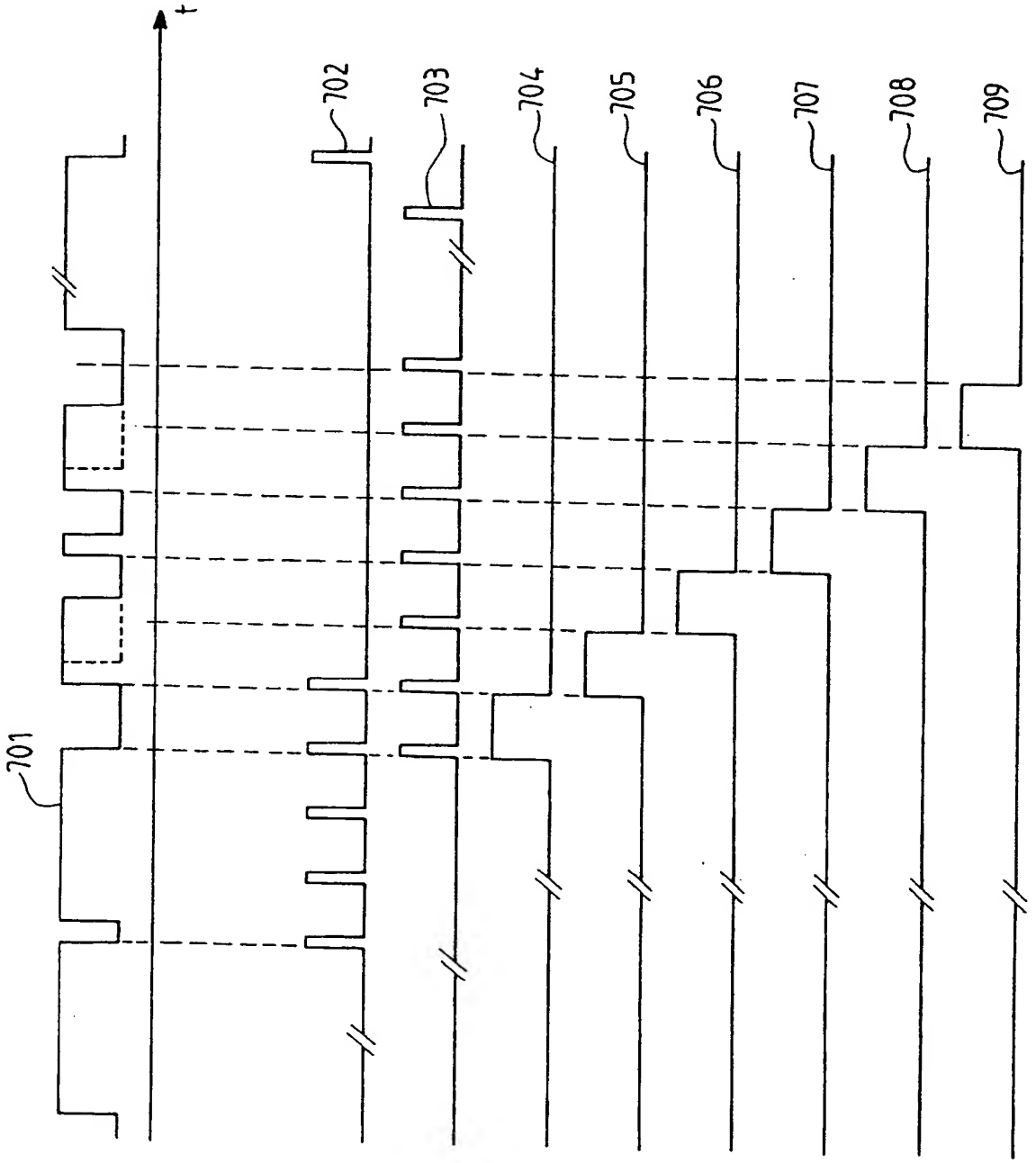


FIG. 5



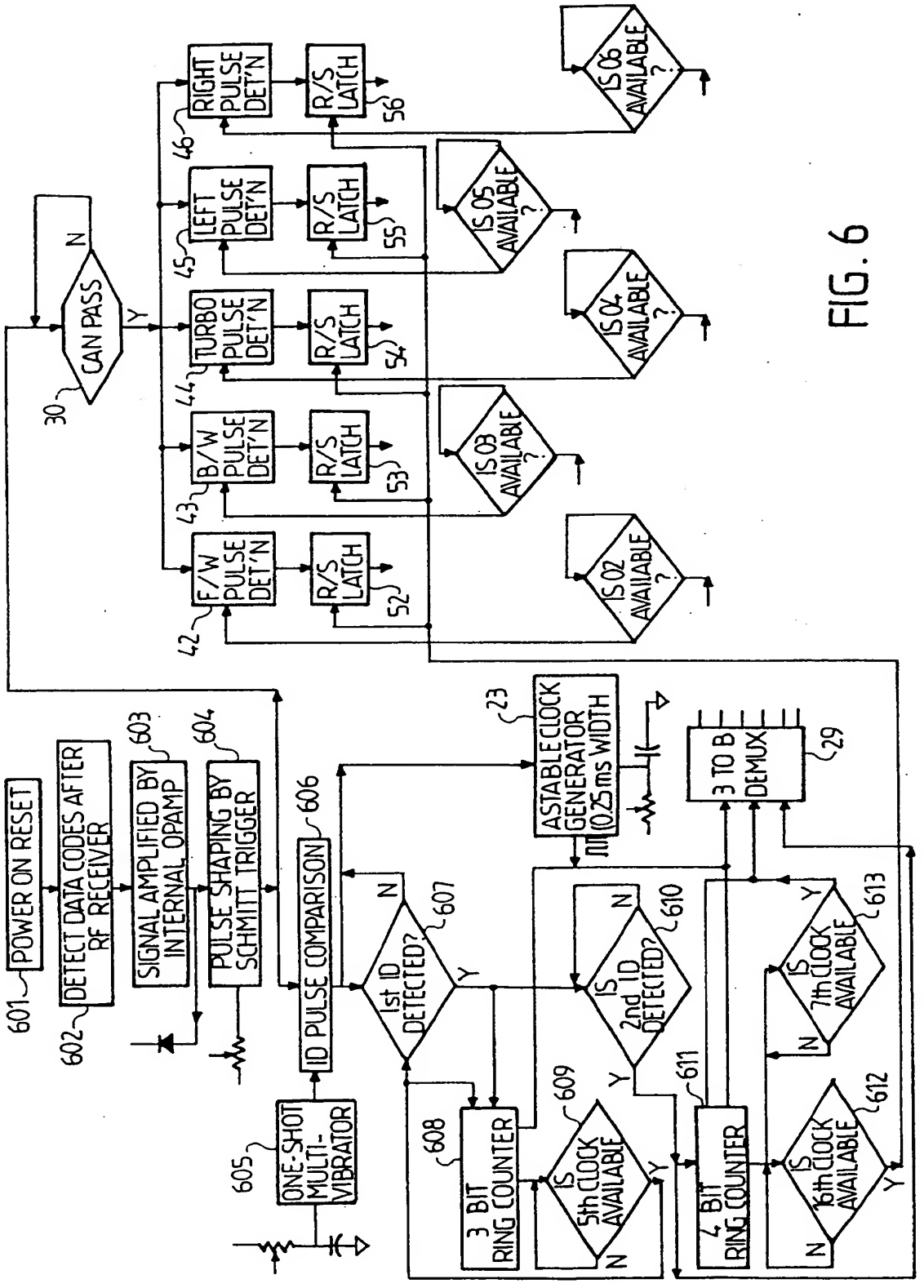

POWER ON RESET
DETECT DATA CODES AFTER RF RECEIVER
SIGNAL AMPLIFIED BY INTERNAL OPAMP
PULSE SHAPING BY SCHMITT TRIGGER
ID PULSE COMPARISON
ONE-SHOT MULTI-VIBRATOR
ASTABLE CLOCK GENERATOR 1025ms WIDTH
1st ID DETECTED?
IS 2nd ID DETECTED?
IS 5th CLOCK AVAILABLE
IS 7th CLOCK AVAILABLE
IS 16th CLOCK AVAILABLE
3 BIT RING COUNTER
4 BIT RING COUNTER
3 TO 8 DEMUX
CAN PASS
F/W PULSE DET'N
B/W PULSE DET'N
TURBO PULSE DET'N
LEFT PULSE DET'N
RIGHT PULSE DET'N
R/S LATCH
IS 02 AVAILABLE ?
IS 03 AVAILABLE ?
IS 04 AVAILABLE ?
IS 05 AVAILABLE ?
IS 06 AVAILABLE ?
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FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 92 40 1653

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 390 877 (CURRAN) * abstract * * column 1, line 35 - column 2, line 20; figures 4-6 *	1-11	A63H30/04 G08C15/12
A	US-A-4 334 221 (ROSENHAGEN ET AL.) * column 2, line 16 - column 3, line 4; claim 1; figures 1-7 *	1-11	
A	EP-A-0 019 448 (CALVIN) * page 2, line 24 - page 3, line 9; figures 1-5 *	1-11	
A	DE-A-3 338 046 (WAGNER ET AL.) * page 5, line 23 - page 6, line 17 * * page 8, line 29 - page 9, line 23; figures 1-3 *	1-11	
A	DE-A-2 903 075 (MEINKE ET AL.) * page 5, paragraph 3 - page 8, line 10; claim 1; figure 5 *	1-10	
A	GB-A-2 006 495 (THE METTOY COMP.,LTD.) * page 1, line 79 - line 119; claims 1,7,8; figure 1 *	1,5	TECHNICAL FIELDS SEARCHED (Int. Cl.5) A63H G08C
A	DE-U-9 111 296 (TAIYO KOGYO CO. LTD.) * claims 1,2,4; figures 5,6 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	21 JANUARY 1993	MICHELS N.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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